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PREVALENCE AND DETERMINANTS
OF ANAEMIA AMONG
UNVIRSITY STUDENTS LIVING IN PUBLIC HOSTELS IN
KHARTOUM STATE

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DEDICATION

- **To the sole of my father and to my mother with love and faith.**

- **To my beloved wife and children.**

- **To all my teachers through my learning journey.**

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Fig	Figure
Hb	Haemoglobin
SD	Sudanese Dinar
N	Sample Size
NSWF	National Students Welfare Fund
BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
EDTA	Ethylenediaminetetraacetic acid
FAO	Food and Agriculture Organization
SPSS	Statistical package for social science
G6PD	Glucose 6 Phosphate Dehydrogenase Deficiency
ICRW	International Center for Research on Women
IQ	Intelligence quotient
OR	Odds ratio
sTfR	Soluble transferrin receptor
UNICEF	United Nation Children's Fund
UNU	United Nation University
WHO	World Health Organization

Abstract

This is a descriptive cross-sectional study conducted among university students living in public hostels (NSWF Hostels) in Khartoum State. This study aimed at assessing the prevalence of anaemia and to investigate the risk factors involved.

Blood samples were collected from 810 university students for the estimation of haemoglobin level.

The overall prevalence of anaemia was 26.2% most of which was mild or moderate, with only one severe case (0.5% of the sample).

A statistically significant difference ($P<0.001$) was found concerning anaemia between males (4.6%) and females (36.6%). The study showed that gender was the most important risk factor. A statistically significant relationship ($P<0.05$) was observed between the level of anaemia and age; it was found that anaemia prevalence decreased with increase of age (28.1% in the age group 16-19 years and 4.3% in those above 28 years). Those who were receiving bursary (the poorest students) were more anaemic.

High prevalence of anaemia was positively associated with infections i.e. typhoid, intestinal worms and dysentery

Anaemia is a moderate public health problem among university students in Khartoum State. Anaemia was found to

be more prevalent among females in younger age groups in those having infections and among the poorest ones. Wide-scale nutrition education should be applied especially targeting young girls, and should be carried out in schools, in universities, in the hostels, and in the community.

خلاصة

هذه الدراسة الوصفية المقطعية أجريت وسط طلاب التعليم العالي الذين يسكنون داخليات الصندوق القومي لرعاية الطلاب في ولاية الخرطوم.

هدفت الدراسة لتحديد معدل انتشار فقر الدم ودراسة عوامل الخطورة الممكنة, وتم أخذ عينات الدم من 810 طالب وطالبة لقياس مستوي خضاب الدم (الهيموقلوبين) لديهم. وثبت أن معدل انتشار فقر الدم الإجمالي يبلغ 26.2% وكان أغلبها حالات خفيفة أو متوسطة, بينما وجدت حالة واحدة وخيمة (0.5%).

كما وجد فرق ذو دلالة معنوية في معدل إنتشار فقر الدم بين الجنسين (36.6% في الإناث 4.6% في الذكور) , حيث أوضحت الدراسة أن أهم عامل خطورة هو الجنس, أيضا لوحظت علاقة عكسية ذات دلالة معنوية بين مستوي فقر الدم والعمر, حيث يقل معدل إنتشار فقر الدم مع زيادة العمر (28.1% في الفئة العمرية من 16 سنة إلي 19 سنة و 4.3% في الفئة أكثر من 28 سنة). كما وجد أن الطلاب الذين يستلمون الكفالة (وهم الأكثر فقرا) يزداد لديهم معدل إنتشار فقر الدم. وهنالك علاقة طردية ذات دلالة معنوية بين زيادة معدل انتشار فقر الدم ووجود العدوى مثل التايفويد, والديدان المعوية, والدوسنتاريا.

إن فقر الدم مشكلة صحية متوسطة الانتشار بين طلاب التعليم العالي الذين يسكنون داخليات الصندوق القومي لرعاية الطلاب في ولاية الخرطوم, وهو أكثر انتشارا بين الطالبات الأصغر سنا والأكثر فقرا اللاتي عانين من عدوي سابقة. الأمر الذي يتطلب تثقيفا صحيا وتغذويا موسعا في المدارس والجامعات والداخليات والمجتمع.

CHAPTER ONE

1. INTRODUCTION & LITERATURE REVIEW

Anaemia is an old enemy and remains a widespread public health problem. [1] It is a major world health problem. Although iron deficiency anaemia is a worldwide health problem it is not seen as a priority. According to WHO 1.3 – 2.15 billion people are anaemic all over the world, more than 90% are living in the developing countries and most of them are due to iron deficiency. [2] Middle East and North African countries share the public health problem of iron deficiency anaemia with other developing countries. It is more noted in pregnant women, preschool children and women in childbearing age. [2]

Iron deficiency is the most common and widespread nutritional disorder in the world. [3] While affecting a large number of children and women in non-industrialized countries, it is the only nutrient deficiency which is also significantly prevalent in virtually all industrialized nations. [4, 5]

There are no current global figures for iron deficiency, but using anaemia as an indirect indicator it can be estimated that most preschool

children and pregnant women in non-industrialized countries are iron deficient. [4, 5] Nearly half of the pregnant women in the world are estimated to be anaemic: 52% in non-industrialized – as compared with 23% in industrialized countries. In industrialized countries, however, most pregnant women are thought to suffer from some degree of iron deficiency. For example, 75% of pregnant women attending universities in Paris showed evidence of depleted iron stores. Anaemia is particularly prominent in south Asia. In India, for example, up to 88% of pregnant women and 74% of non-pregnant women are affected. Throughout Africa, about 50% of pregnant and 40% of non-pregnant women are anaemic. West Africa is the most affected, and Southern Africa is the least. In Latin America and the Caribbean, prevalence of anaemia in pregnant and non-pregnant women are about 40% and 30% respectively. The highest levels are in the Caribbean, reaching 60% in pregnant women on some islands. [5, 4]

Prevalence data for various age groups are not available for all countries. However, the prevalence rate among preschool children is usually similar to, or higher than, the rate among the pregnant women. [6]

Higher education is considered the most important factor for accelerating economic, social, and cultural development in human communities. The necessity of this type of education for developing

communities is basically to achieve social equality, capacity building to cope with the developments in the world. There is also a necessity to eradicate ignorance, disease, poverty and backwardness.

Responding to this vital role of higher education, the government of Sudan planned for a revolution in this sector, in this regards, the number of universities in Sudan has jumped from six universities in the year 1989 to almost 68 higher education institutes in 2006, 32 of them are in Khartoum State (26 are private institutes and 6 are governmental). The number of the university students jumped from 38000 to 398733 students; Out of this number 66.4% i.e. 264752 are enrolled in universities of Khartoum State. About 34683 were living in about 52 youth hostels, 11559 of them were boys living in 15 hostels and 23124 were girls. All of them were from outside Khartoum State and cannot afford to live in private hostels.

According to the rapid and large increase in the university student's number, many problems were emerging e.g.: academic, socioeconomic, and health problems including nutritional deficiencies. So the government established the National Students Welfare Fund to separate what concerns the student's academic activities from the process of housing and feeding. The Fund helps the students to overcome those difficulties by offering them housing, financial support to the poor ones,

transport and health care. The Fund has played the social role of making higher education possible for the most needy persons. Housing is crucial for those who's families are living outside Khartoum State, so all students living in these hostels were from other States and cities and villages away from the Capital of the country.

This study was performed during 2006 to investigate the prevalence of anaemia among university students living in public hostels, and to study factors affecting the study population.

1.1: The Definition of Anaemia

Anaemia: is a State when the circulating red blood cell mass is insufficient to meet the oxygen requirement of the tissues i.e. reduction of the haemoglobin concentration, red cell count or packed cell volume to bellow normal levels.

It has been extremely difficult to establish a normal range of haematological values, but the World Health Organization recommends that anaemia should be considered to exist in adults whose haemoglobin levels are lower than 13 g/ld for males or 12 g/dl for females. Children aged 6 month to 6 years are considered anaemic at haemoglobin levels below 11 g/ld, and anaemia is present if haemoglobin is below 12 g/ld for those aged 6 to14 years. The disadvantage of such definition is that there

may be many apparently normal individuals whose haemoglobin level is below the above-mentioned levels. [7]

1.2: Factors Required for Normal Erythropoiesis

Erythropoiesis is the formation of red cells. The red-cell precursors are derived from pluripotential stem cells by a differentiation step. The level of tissue oxygenation stimulates erythropoiesis and it is regulated by the hormone erythropoietin. Thus if the haemoglobin level falls or if the oxygen supply to the tissues is reduced, there is an increased production of erythropoietin, which stimulates the bone marrow to increase the out put of red cells until oxygen delivery is restored to normal.

There are several factors that are involved in the normal function of the bone marrow. Iron is required for haemoglobin synthesis and also seems to have a direct effect on the regulation of erythroid proliferation. Vitamin B_{12} and folate are required for normal DNA synthesis and hence for nuclear maturation. It has been suggested that certain other vitamins including pyridoxine, ascorbic acid, riboflavin, and vitamin E are essential for erythropoiesis in man, also, certain trace elements such as copper, manganese, cobalt, and zinc may also be required. [7]

1.3: The Definition of Iron Deficiency

Iron deficiency is defined as a condition in which there is no mobilizable iron stores and in which signs of a compromised supply of iron to tissues (including the erythron) are noted. [6] Insufficient iron will affects the normal physiological function of tissues such as the blood, brain, and muscles. [8] The more severe stages of iron deficiency are associated with anaemia. Iron deficiency anaemia should be regarded as a subset of iron deficiency that represents the extreme lower end of the distribution of iron deficiency. [6]

Iron containing compounds in the human body are present in three groups, a group in which iron has a vital functional role, and a group that maintain body iron transport, and lastly a group of iron storage. All the three groups need to be considered when assessing disturbance of iron status. [7]

Storage iron is the pool of iron in the body that is not being used by tissues. Healthy children and adults (apart from infants aged 6-11 months and pregnant women) usually have some iron stores to act as a buffer against iron deficiency during periods when dietary iron is temporarily insufficient. Iron depletion is the state in which storage iron is absent or

nearly absent but the tissues that need iron are able to maintain normal physiological functions. [8]

Functional iron deficiency can develop even when iron stores are present if the normal systems for transporting iron are impaired. This occurs most commonly because of cytokines released during inflammation caused by infectious diseases. [9] Iron supplementation or fortification has no benefit in such circumstances. Deficiencies of other nutrients such as vitamin A may also cause a functional iron deficiency even when iron stores are adequate. [10]

1.4: Classification of Anaemia According to the Cause.

- Reduced red-cell production:
    - Defective precursor proliferation
    - Defective precursor maturation
    - Defective proliferation and maturation
- Increased rate of red-cell destruction:
    - Haemolysis
- Loss of red cells from the circulation:
    - Bleeding. [7]

1.5: Assessment of Iron Level

Biochemically iron is assessed by level of haemoglobin, haematocrit, serum ferritin, transferrin saturation, erythrocyte protophyrin, and total iron binding capacity. However, in clinical practice there is no one test or combination of tests that is optimal for all circumstances, this is because abnormalities may affect only one iron compartment or may develop sequentially. In addition factors other than iron status affect many of the measurements. Still serum ferritin when measured in the absence of infection is the best indicator for detecting iron deficiency, and under the same conditions elevated erythrocyte protophyrin indicate iron-deficient erythropoiesis and it is less specific than serum ferritin. Transferrin saturation is less reliable as an indicator of iron deficiency because of intra – and inter-day variability in serum iron. As a consequence of the limitations of each test, when they are considered jointly to define iron deficiency, sensitivity is low although specificity increases. [6, 7]

1.6: Population- based Assessment of Iron Deficiency

The best combination used would be haemoglobin, serum transferrin receptors, and serum ferritin. Such a combination would

reflect functional impairment, tissue affinity for iron, and iron storage. This approach is not feasible in settings with resource constraints. [7]

1.7: Assessing Population Iron Status by Using Haemoglobin Distribution

Estimates of haemoglobin are commonly included in nutrition surveys of children, whereas surveys specific for anaemia usually examine both children and women, the prevalence of anaemia serves as an index of the severity of iron deficiency in the whole population putting in mind that it is a rough estimate. [6]

Because anaemia is the most common indicator used to screen for iron deficiency, the terms anaemia, iron deficiency and iron deficiency anaemia are sometimes used interchangeably. There are, however, mild to moderate forms of iron deficiency in which, although anaemia is absent, tissues are still functionally impaired. In addition, although iron deficiency anaemia accounts for most of the anaemias, several other possible causes should be considered. These include haemolysis occurring with malaria, glucose-6-phosphate dehydrogenase deficiency, congenital hereditary defects in haemoglobin synthesis, and deficits in other nutrients e.g. vitamin A, B_{12}, C and folic acid, also blood loss associated with parasitic infestations. [6]

There is no international agreement on how to assess the iron status of populations, so prevalence of anaemia (haemoglobin concentration) has often been used to determine the prevalence of iron deficiency. [11]

Epidemiological mapping of prevalence requires cut-off levels, or criteria for grading the public health severity of anaemia, as shown in the following table:

Table (1) Grading Levels of Anaemia

Range of anaemia		***Magnitude of public health problem***
1 – 9%	0.1–0.9%	Mild
10 – 39%	1-9%	Moderate
> 40%	>10%	Severe

(From UNICEF Regional Office for the Middle East and North Africa 1993)

In most industrialized countries, the prevalence of anaemia among pregnant women is around 20%. It is therefore considered reasonable to classify these populations as having a medium prevalence, since a

prevalence of up to 5% may not necessarily be regarded as abnormal in any population. [2]

1.8: Functional Consequences of Iron Deficiency

The pallor of anaemia was associated with weakness and tiredness long before its cause was known. Now it is recognized that even without anaemia, mild to moderate iron deficiency has adverse functional consequences on:

- Cognitive performance, behavior, and physical growth of infants, preschool and school-aged children;
- The immune status and morbidity from infections of all age groups.
- The use of energy sources by muscles and thus the physical capacity and work performance of adolescents and adults of all age groups.

1.8.1: Cognitive development

In experimental animals, iron has an important role in brain function. Iron-deficient animals show alteration in neurotransmitters and in behaviour. This can be applied to humans, as iron deficiency anaemia has been conclusively seen to delay the psychomotor development and impair the cognitive performance of infants in Chile [12] and in Indonesia. [13]

Also iron deficiency anaemia impair the cognitive performance in preschool and school children in Egypt [14] and India. [15]

Supplementation of the diet of the adolescent girls with iron improved their mood, their ability to concentrate in school, and they felt less fatigued. [16] On the other hand, in Thailand the poor performance in Thai language and mathematics tests of children with low haemoglobin levels was not reversed by iron supplementation. [17]

Thus, iron deficiency can impair cognitive performance at all stages of life. And the effect of iron deficiency anaemia in infancy and early childhood are not likely to be corrected by subsequent iron therapy. An estimated 10-20% of preschool children in developed countries, and an estimated 30-80% of in developing countries, are anaemic at 1 year of age. [4] These children will have delayed psychomotor development, and when they reach school age they will have impaired performance in tests of language skills, motor skills, and coordination, equivalent to a 5 to 10 points deficit in IQ.

1.8.2: Resistance to infection

Because of the adverse effect of iron deficiency on the immune system, Morbidity from infectious disease is increased in iron-deficient populations. In these situations the killing capacity of leukocytes reduced,

and the lymphocytes ability to replicate when stimulated also decreased. Also there is a lowered concentration of cells responsible for cell-mediated immunity. [18]

1.8.3: Work capacity and productivity

Work capacity decreased in iron deficient agricultural workers in Guatemala. [19] The work capacity returned rapidly to normal with iron supplementation.

1.9: Iron Deficiency Anaemia During Pregnancy

- Increases prenatal risks for mothers and neonates; and
- Increases overall infant's mortality. [20]

Moreover, iron-deficient animals and humans have impaired gastrointestinal functions and altered patterns of hormone production and metabolism. The latter include those for neurotransmitters and thyroidal hormones, which are associated neurological, muscular, and temperature-regulatory alterations that limit the capacity of individuals exposed to the cold to maintain their body temperature. In addition, DNA replication and repair involve iron-dependent enzymes. [6]

1.10 Epidemiology of Iron Deficiency Anaemia

The prevalence of iron deficiency varies greatly according to host factors i.e. age, gender, physiological, pathological, environmental, and socioeconomic conditions. [6]

1.101: Age

Full-term infants are normally born with adequate iron stores in the liver and haematopoietic tissues, because of destruction of fetal red blood cells soon after birth. This leads to deposition of iron in these tissues, especially if the cord is ligated after it stops pulsating.

Breast milk is relatively low in iron, although the iron in breast milk is much better absorbed than that in cow's milk. Iron deficiency commonly develops after six month of age if complementary foods do not provide sufficient absorbable iron.

Iron requirements on a body weight basis are proportional to growth velocity. Accordingly, in addition to women in their reproductive years as a result of physiological losses, iron deficiency is most common in the preschool years and during puberty. Another peak may occur in old age, when diets frequently deteriorate in quality and quantity.

1.10.2: Gender

Following menarche, adolescent females often do not consume sufficient iron to offset menstrual losses. As a result, a peak in the prevalence of iron deficiency frequently occurs among females during adolescence.

1.10.3: Physiological State

Substantial amounts of iron are deposited in the placenta and fetus during pregnancy. This results in an increased need of about 700-850 mg, in body iron over the whole pregnancy. Overall, iron absorption is increased during pregnancy, when menstruations stop. Pregnant women still do not absorb the sufficient additional iron, however, and the risk of iron deficiency increases.

Lactation results in loss of iron via breast milk. Consequently, for some women a deficiency developed during pregnancy may be perpetuated during lactation. In terms of iron balance, however, lactational amenorrhea more than compensates for iron lost through breast milk.

1.10.4: Pathological State

Common infections, especially those which are chronic and recurrent, may impair haematopoiesis and consequently cause anaemia. Malaria by haemolysis and some parasitic infections, e.g. hookworm, trichuriasis, amoebiasis, and schistosomiasis (both vesical and intestinal forms), cause blood loss directly. This blood loss contributes to iron deficiency.

Other important causes of anaemia include genetic factors. e.g. thalassemia, sickle cell trait, and glucose-6-phosphate dehydrogenase deficiency (G6PD)

These other causes of anaemia are mentioned, however, as a reminder that they should be considered when choosing and focusing on population groups for assessment and surveillance purposes. In this way, more appropriate interventions can be developed. It should also be noted that these genetic conditions, except for the thalassemia major (which is rare) do not prevent the development of iron deficiency, and may coincide with it.

1.10.5: Environmental factors

A given diet may be low in iron or may contain adequate amounts of iron, which are of low bioavailability. Other nutrients necessary for haematopoiesis may also be deficient. These include folic acid, vitamin A, B_{12} and C, protein and copper and other minerals. [21]

Trauma or childbirth can result in acute or chronic blood loss, with consequent iron deficiency and anaemia.

1.10.6: Socioeconomic status

Iron deficiency is most common among groups of low socioeconomic status.

1.11: Anaemia in the Eastern Mediterranean Region

Anaemia, particularly attributed to iron deficiency, among infants, preschool children and women of childbearing age has remained a widespread public health problem, irrespective of the family economic status and income level in most countries of the region. The overall situation of anaemia in countries of the region was studied in 1995 although the terms anaemia and iron deficiency anaemia were used interchangeably. [22] The prevalence rate of anaemia was reported to be moderate in magnitude when compared with other developing regions,

which could be partially due to under-reporting and lack of nationally representative data. A few countries had up-to-date national-level data on anaemia while available information in the majority of the situations was based on ad hoc surveys or small-scale studies on specific population groups.

The prevalence of anaemia in women of childbearing age ranged from around 20% in Jordan, parts of Egypt and parts of Oman to more than 60% in countries like Djibouti. Preschool children were more affected than women, with reported prevalence in excess of 60% in many countries. [22]

Low intake of total dietary iron, proportionate high consumption of non-heame iron, poor iron absorption due to iron-absorption inhibiting factors, such as tannins in tea and phytates in unleavened bread, were identified as the common causes of anaemia. In addition high birth rates, short birth intervals and concurrent parasitic infections are also incriminated in causing anaemia. In Egypt, the importance of genetic factors, particularly thalassaemias, remained another possibility but required further research for any conclusion to be drawn. [22]

All assessments of the public health importance of anaemia carried out have continued to report high prevalence of anaemia, mostly attributed to iron deficiency, with similar causative factors.

A review of published studies from countries of this region indicates the persistency of anaemia (presumably iron deficiency anaemia) in different age groups.

Among infants from 6 month onwards, a high prevalence of anaemia is reported, with iron deficiency anaemia being the single most important cause. The prevalence of anaemia in preschool children has also remained high, varying from 29% to over 60%. Among preschool children, the magnitude of anaemia is reported to be associated with birth order (thereby indicating a gradual depletion of the iron stores of mother after repeated pregnancies) low dietary iron intake, socioeconomic status and literacy level of mothers. [(1)]

Among women of childbearing age, from both rural and urban backgrounds, prevalence of anaemia has ranged between 20% and 70%, again mostly attributed to iron deficiency, in addition to deficiencies of folic acid and vitamin B_{12}. Income, literacy and family size are factors that affect total iron intake and anaemia status. Women with anaemia are reported to have high fetal mortality and deliver babies with lower birth

weight, and low haemoglobin and serum ferritin levels as compared to non-anaemic women in different gestational age groups. [23]

Most studies on adolescents have reported prevalence rates for anaemia ranging from 30% to 55% with the milder from of anaemia predominating (80%). Occasional reports have indicated improvement in anaemia status in this age group [23]. The high prevalence of anaemia among adolescents has been attributed to increased needs for iron due to rapid growth and menarche, low intake of iron-rich foods, inappropriate dietary choices, intestinal parasitic infestation and frequent consumption of tea with meals, altogether or in various combinations. The prevalence of anaemia declined sharply in boys after the age of 16 years coinciding with the end of growth spurt while the prevalence of anaemia among girls started to rise after the age of 18 years as they proceeded to the menstruation, marriage and childbearing. [24]

1.12: Anaemia in Africa

A study done in Cote d'Ivoire in December 1996 to estimate the prevalence of iron deficiency with or without anaemia and to evaluate the influence of infectious and inflammatory disorders on iron status indices showed that the prevalence of iron deficiency was 41%- 63 % in women and children and 13% in men, whereas the prevalence of iron deficiency

anaemia was 20%-39% in women and children and 4% in men. The detection of iron deficiency and iron deficiency anaemia was obscured by the high prevalence of inflammatory disorders. The study concluded that, iron deficiency and iron deficiency anaemia are highly prevalent in the women and children in Cote d'Ivoire. Iron deficiency was detected in 50% of anemic women and children, which indicates that hemoglobin alone is not a good indicator of iron status when inflammatory disorders are highly prevalent. The serum transferrin receptor is the most useful single indicator of iron deficiency because it was the only iron – status index unaffected by malaria or inflammation. [25]

Iron deficiency and anaemia in school-attending girls in western Kenya were more prevalent than in developed countries, but considerably less prevalent than in preschool children and pregnant women from the same study area. The prevalence of anaemia (Hb <120 g/1) was 21.1%; only one girl had Hb less than 70 g/1. Ferritin levels were available from a sub sample of 206 girls. The prevalence of iron deficiency (ferritin<12 g/1) was 19.8%, and 30.4% of anemic girls were iron deficient. Malaria, schistosomiasis were the main risk factors for anaemia in younger girls 12-13years old, while menstruation was the principal risk factor in older girls 14- 18 years old. [26]

Antenatal attending women were screened for anaemia in South Southern Nigeria, for 1 year (October 2000- September 2001) at the booking clinics in three government hospitals in Kwale zone. The prevalence of overall anaemia and severe anaemia was found to be 56.1% and 6.7%, respectively. Independent risk factors for anaemia and severe anaemia were primigravidity, booking in late pregnancy and wet season. (27)

In a community, cross-sectional study in southern Tanzania, five hundred and seven pregnant women were studied. They found that anaemia in pregnancy is associated with maternal morbidity and mortality and is a risk factor for low birth-weight. (11%) were severely anemic (<8g Hb/dl). High malarial parasitaemia [odds ratio (OR)= 2.3] and iron deficiency (OR=2.4) were independent determinants of anaemia. Being a single mother (OR=2.9) was the most important socio-economic predictor of severe anaemia. In the study a subject recruited in the early dry season was six times more likely to be anaemic than those recruited in the late dry season. (28)

In a Tanzanian suburban area, anaemia (Hb <105 g/l) was highly prevalent (75.5%) in adolescent primigravidae. Adolescent girls were more anaemic (Hb <120 g/l) than boys 14.5% vs. 7.9%. Iron deficiency and hookworm infestation were predominant in both groups of

adolescents, however, malaria contributed more to anaemia in the primigravidae. Nearly 40% of the anaemic primigravidae had indication of infection, and S-ferritin was less useful as a marker of iron deficiency in this group. sTfR identified iron deficiency in both pregnant and non-pregnant adolescents. [29]

1.13: Anaemia in Sudan

Most of the anaemia studies in Sudan were done among pregnant women and children, especially in displaced and refugees camps. There is scarcity of information about anaemia and iron deficiency anaemia among the adolescents and other age groups.

Anaemia is considered as a public health problem in the country's FAO-nutrition profile. In a study in Wad Medani 121 pregnant women were investigated and the results revealed that anaemia was prevalent among 36% of them. [2]

In a study conducted in the antenatal clinic of New Halfa teaching hospital, eastern Sudan between October 2003 and April 2004, 744 pregnant women were screened. The study showed that 62.6% of the women had anaemia (Hb <11 gm/dl); 52.4% of them had mild anaemia (Hb 9.0-10.9 gm/dl); 8.1% had moderate anaemia (Hb 7.0-8.9 gm/dl);

and 2.2% had severe anaemia (Hb <7 gm/dl). Malaria was the most prominent risk factor. [30]

A survey conducted in Juba teaching hospital among 1847 patients irrespective of complaint, showed presence of anaemia in 79.53% of cases. The prevalence in children under 9 years old was 94.83%. [31]

Mohamed Moukhyer stated that, in Sudan, the prevalence of anaemia among adolescents is 32%. [32]

1.14: Justification of the Study

Anaemia is a major health problem in many countries especially among pregnant women, and it is present among all age groups, yet anaemia did not get enough attention although the management is not difficult.

In Sudan, there has no much work on prevalence of anaemia especially among university student. Most of the work was done among pregnant women and among children. Furthermore the effect of poverty and lack of knowledge with other factors are the main causes leading to iron deficiency anaemia.

There is an assumption that the university students living in the public hostels are nutritionally deficient. Because they can not feed

themselves well due to poverty and lack of good choices in their meals. Also the restaurants located inside the hostels serve cheap meals, which are poor in meat.

Findings of the study will help the administration of the National Students Welfare Fund in future planning and setting priorities

1.15: Objectives

1.15.1: General Objectives

To measure the prevalence and determinants of anaemia among university students in Khartoum State, 2006.

1.15.2: Specific Objectives

To measure the prevalence rate of anaemia among university students to relate it to the following:

- *The socio-economic status of the study population*

- *The nutritional level of the study popula*

CHAPTER TWO

2. METHODS AND MATERIALS

2.1: Study Design

This is a descriptive, cross sectional study conducted among university students living in governmental hostels in Khartoum State in 2006.

2.2: Study Area

Khartoum State is the capital of Sudan, it lies between latitude 15.1 to 16.3 degrees north and longitudes 31.3 to 34.2 degrees east. It is one of the 25 States of Sudan, and it is surrounded by 7 States. The total area of Khartoum State is 28140 km square and it is divided into 7 localities. The population of Khartoum State is about 5,948,700 persons with an annual growth rate of 6.29.

In Khartoum State there were 6 governmental universities, 32 private universities and colleges. Another 3 southern States universities were hosted in Khartoum.

The total number of students is 264,752, out of which 125,212 are males and the rest (52.7%) are females (139,540).

There are 136 private hostels accommodating about 4000 students, and 52 public hostels accommodating about 34683 students.

2.3: Study Population

Our target population in this study is the university students living in 52 public hostels, 15 of them were allotted for boys and 37 of them were for girls, accommodating about 34683 university students (11559 of them are boys, and 23124 of them are girls) from the total number of the students in Khartoum State (264752).

The 52 public hostels are located in Khartoum (18 hostels), Bahri (8 hostels) and Omdurman (26 hostels). The capacity of these hostels is varying from 40 students per hostel to 4387 students. There are 8 to 10 student in each room, and a rate of 20 to 25 students per toilet. All of them have access to adequate safe water and toilets. The students buy their meals from the private cafeterias established inside the hostels.(Annex 1)

2.4: Inclusion and Exclusion Criteria

2.4.1: Inclusion criteria

The study included all university students eligible for living in public hostels both males and females. The criteria of being eligible are being a registered student in one of the 6 governmental universities in Khartoum State, enrolled in university studies of duration not less than four years, and originally lives outside Khartoum State.

2.4.2: Exclusion criteria

1. Foreigners
2. Guests
3. Refusals
4. Postgraduates

2.5: Sampling Procedure

2.5.1: Sampling frame

The frame of this study is prepared by the National Students Welfare Fund. The design suggested for the sampling technique will be mainly stratification so as to reduce the sampling error of the study. Stratification in this study was based on the following:

- Localities
- Gender

Students were selected using the stratified cluster sampling technique, all hostels in the State were divided into three strata by locality (Khartoum, Omdurman, Bahri). The sample size was calculated according to the population size between the strata. In the second stage the classification of gender into male and female hostel, the strata were further divided into 20 clusters, and these were selected according to probability proportional to population size at the level of each cluster. Hostels and students were selected using systematic random sampling technique.

2.5.2: Sample size

n = Z2pq /d2 X2

n = sample size

Z = value of normal curve corresponding to level of

confidence 95% = 1.96)

p = expected prevalence of anaemia

q = 1- P

d = desired margin of error (5%)

With 95% confidence and 5% accuracy the sample size will be:

384 X 2 (design effect) = 768 + 38 (5% of the calculated sample size to guard for non respondents) = 806.

The sample size was 810 students.

2.6: Data Collection Methods

2.6.1: Study variables

1. Socio-demographics

   Region / Residence / Gender / Age / Family size /

   Marital Status / Income

2. Health problems

   Hb level

3. Symptoms of anaemia

   Fatigue / Weakness / Hair-falling / Dizziness

2.6.2: Tools of data collection

2.6.2.1: Questionnaire

The data were collected by an interview and a structured, precoded and pre-tested questionnaire (Annex 2). The data collectors were trained on proper filling of the questionnaire. The respondents were students.

2.6.2.2: Data collection:

The data were collected during September 2006. The survey was conducted in three phases. The 1st phase comprised introductory information and getting the consent from the participating students. During the 2nd one interviews were conducted by filling the questionnaire. The 3rd was devoted mainly for collecting 2.5 cc venous blood from each student. The blood was collected in EDTA anticoagulant (10% 20microlitre EDTA) and mixed thoroughly to avoid fibrin formation or platelet aggregation. The blood specimens were sent to the *Laboratory Diagnosis And Consultation Center* (which is a private laboratory in Khartoum) to be tested in the same day.

2.6.2.3: Laboratory investigation:

Procedure of the test:

The tests were done by Automated Haematology Analyzer (Sysmex KX-21N made in Japan). The blood sample was diluted with Cellpack in a WBC counting container. Then a fixed volume of STROMATOLYSER-WH solution, which is 8.5*g/l* organic quaternary ammonium salt and 0.6*g/l* sodium chloride, (1volume of STROMATOLYSER-WH to 2 volume of Cellpack) is added automatically to obtain a final dilution of 1:500. The addition of STROMATOLYSER-WH lyses the RBCs and so the remaining of the stroma is at a level undetectable by the instrument. Haemoglobin is released during RBC lyses. And is converted to the red methemoglobin. A portion of this diluted sample is transferred automatically to the haemoglobin detector where the absorbance of the red pigment is measured to give blood haemoglobin level.

2.6.2.4: Iron Status Indicators:

- Haemoglobin

Decision rules will be predetermined on cut-off points and criteria of levels of severity and significance as a public health problem, in accordance with WHO/CDC 2004 guidelines, (epidemiologic criteria for assessing the prevalence and severity of iron deficiency anaemia). [(2)]

2.6.2.5: Cut – off levels of anaemia:

Anaemia was considered to be present if the Haemoglobin value was below 13g/dl for boys and below 12g/dl for girls above 14 years, as proposed by WHO. Anaemia is classified into three categories, according to severity: mild (Haemoglobin level between 10g/dl to the cut-off); moderate (Haemoglobin level 7 - 9.9 g/dl); and severe (Haemoglobin level <7g/dl). [(5)]

2.6.2.6: Height:

The student was requested to stand erect, barefooted and without head cover against the wall. The head was fixed neutrally and a mark was drawn on the wall with the meeting point of a ruler placed horizontally on the head, then by using measuring tape the height was read to the nearest 0.5 cm.

2.6.2.7: Weight:

Weight was done with minimum clothing, bare footed on a flat scale. The scale was adjusted to the zero point in each case for accuracy and the reading was made to the nearest 100 grams.

2.6.3: Data analysis:

The questionnaires were reviewed firstly for completeness and consistency. Data was entered, cleaned and analyzed using the statistical package for social science (SPSS) programme.

Descriptive statistics were used to calculate the frequencies and the average values, percentages were used to explain the values for the qualitative variables, the average for quantitative variables (mean, standard deviation) median were also calculated.

For the qualitative data chi-square test was used to compare between the sub-groups and a P-value < 0.05 was considered statistically significant.

Multivariate data analysis (logistic regression) was applied to the data to get the main factors affecting anaemia among university students living in public hostels

2.6.4: Data presentation:

Presentation of data was done in forms of graphs and tables.

2.6.5: Ethical considerations:

Approval of the study was obtained from higher authorities of the National Students Welfare Fund. All respondents gave their consents. The same identification codes were used on the questionnaire and the blood containers to ensure accuracy and confidentiality.

2.6.6: Limitations:

- Limited finances unabled us to test for iron.
- The study is limited to students eligible for public hostels accommodation

CHAPTER THREE

3. RESULTS

The following results were obtained from 810 selected students living in public hostels located in Khartoum, Bahri, and Omdurman. The study was conducted during September 2006. All the hostels were public and supervised by the National Students Welfare Fund.

3.1: Socio-demographic characteristics:

Most of the students were from the central region of Sudan (67.3%), followed by those who came from the west (12.8%), north (9.4%) and the east (7.4%). The least percentage of the students were from the south (2.6%). Those who came from urban areas (cities) constituted 45.9% and those from rural areas (villages) constituted 54.1% (Table 2).

Table (2) Distribution of University Students by Region and Residence, Khartoum State, September 2006 (n = 810)

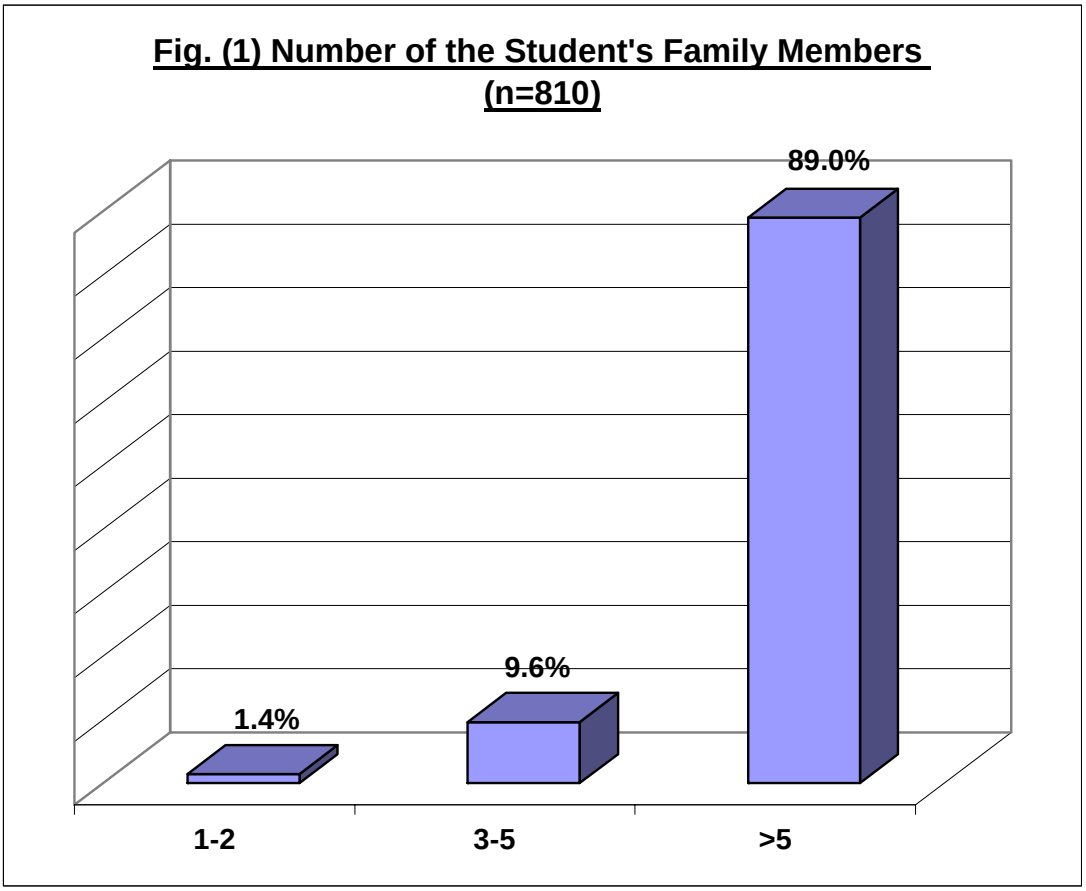
Region	**Frequency**	**Percent %**
Central	545	67.3
North	76	9.4
South	21	2.6
East	60	7.4
West	104	12.8
Data not collected	4	.5
Total	810	100
Residence		
Urban	372	45.9
Rural	438	54.1
Total	810	100

Out of 810 students 32% were males, while 68% of them were females. The highest recorded age group (58.9%) was between 20-23 years old, and the least percentage (2.8%) was observed among the age group above 28 years. The other age groups 16-19 years old and 24-27 years old constituted 25.9% and 12.3% respectively. The mean age was 21.3 ± 0.9(Table 3).

Table (3) Distribution of University Students by Gender and Age, Khartoum State, September 2006 (n = 810)

Gender and age	***Frequency***	***Percent***
Gender		
Male	259	32.0
Female	551	68.0
Total	810	100
Age in years		
16-19	210	25.9
20-23	477	58.9
24-27	100	12.3
28+	23	2.8
Total	810	100

Figure 1 shows that 89% of the study population came from families with family size more than 5 members while 1.4% of them came from families with a family size ranging between 1-2 individuals (the mean family size = 8.5± 0.09).



The Distribution of the students by marital status is shown in table 4. Those who were singles constituted 98.5% of the study population, while the percentage of the married ones was only 1.5%.

Table (4) Distribution of University Students by Marital Status, Khartoum State, September 2006 (n = 810)

Marital status	***Frequency***	***Percent %***
Married	12	1.5
Single	798	98.5
Total	810	100

The students receive monthly allowances from their families, so 47.3% were receiving less than 10,000 Sudanese Dinars per month, and 7.5% were given more than 20,000 Dinars (Table 5).

Table (5) Distribution of Students by Monthly Income in Sudanese Dinars, Khartoum State, September 2006 (n = 810)

Monthly income	***Frequency***	***Percent %***
<10000 SD	383	47.3
10000-15000 SD	252	31.1
15100-20000 SD	114	14.1
>20000 SD	61	7.5
Total	810	100

For the poorest students the fund supports them by a monthly bursary and it was found that 53.1% of them received this bursary while the rest 46.1 were not supported by the fund (Table 6).

Table (6) Distribution of the Bursary Given to the Poorest Students by National Students Welfare Fund, Khartoum State, September 2006 (n = 810)

Receiving the bursary	***Frequency***	***Percent %***
Yes	430	53.1
No	380	46.1
Total	810	100

The students sample was drawn from different Universities and different faculties. Three quarters of the students (75.7%) were enrolled in the faculties of sciences (i.e. medicine, laboratory technology, mathematics, engineering etc…) and the rest were from the faculties of arts e.g. arts, social sciences, economics, etc…(Table 7).

Table (7) Distribution of the Students by Faculties, Khartoum State, September 2006 (n = 810)

Faculties	Frequency	Percent %
Faculties of sciences	613	75.7
Faculties of arts	197	24.3
Total	810	100

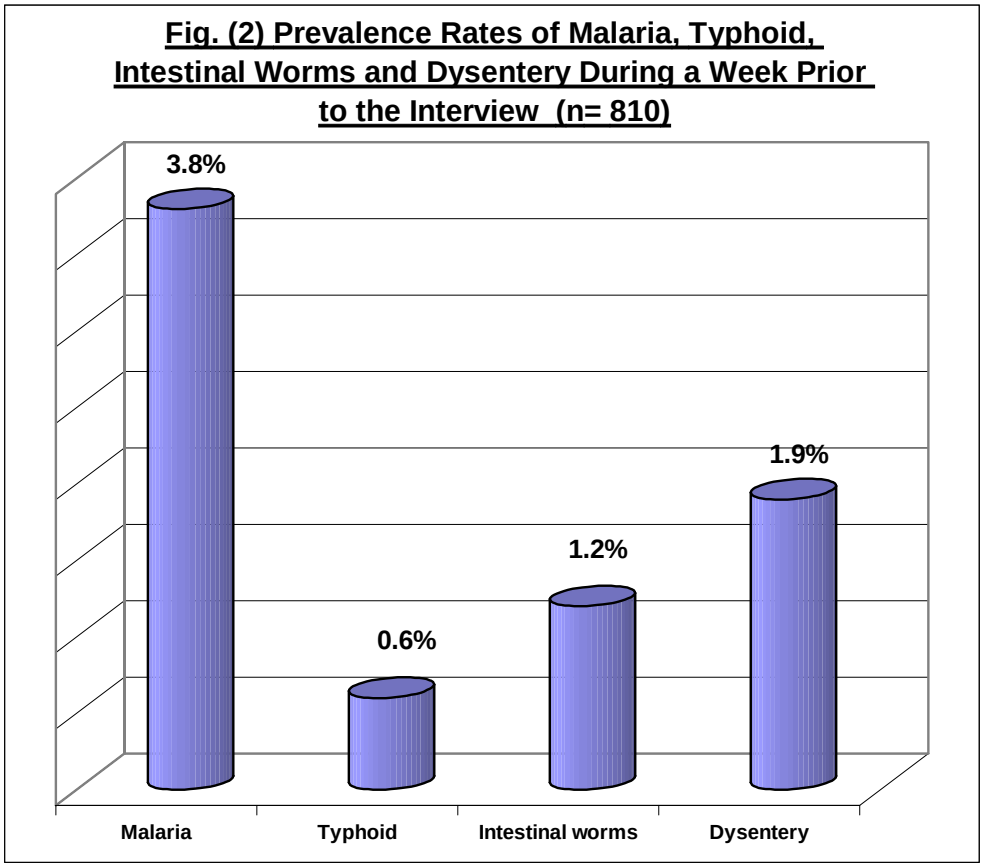
The students were selected from different academic classes as shown in (Table 8).

Table (8) Distribution of the Students According to the Academic Year, Khartoum State, September 2006 (n = 810)

Academic year	Frequency	Percent %
1st	169	20.7
2nd	249	30.7
3rd	198	24.4
4th	161	19.9
5th	26	3.2
6th	8	1
Total	810	100

3.2: Health problems:

Certain common infectious diseases in Sudan were selected. They are having an impact on the nutritional status and /or the haemoglobin level. The selected diseases were malaria, typhoid fever, intestinal worms and dysentery. The students were asked about having these diseases during the week prior to the date of the interview. The results are shown in Fig.2. Malaria was prevalent among 3.8% of them. The recorded prevalence of dysentery, intestinal worms and typhoid were 1.9%, 1.2% and0.6% respectively.



Symptoms of anaemia were present as follows: 36.5% of them complained of tiredness, 24.7% had generalized weakness, 46.4% had hair falling, 29.5% suffered from dizziness and 25.3% with palpitation (Fig.3).

Fig. (3) The Anaemia Symptoms Among Students Study Population (n= 810)

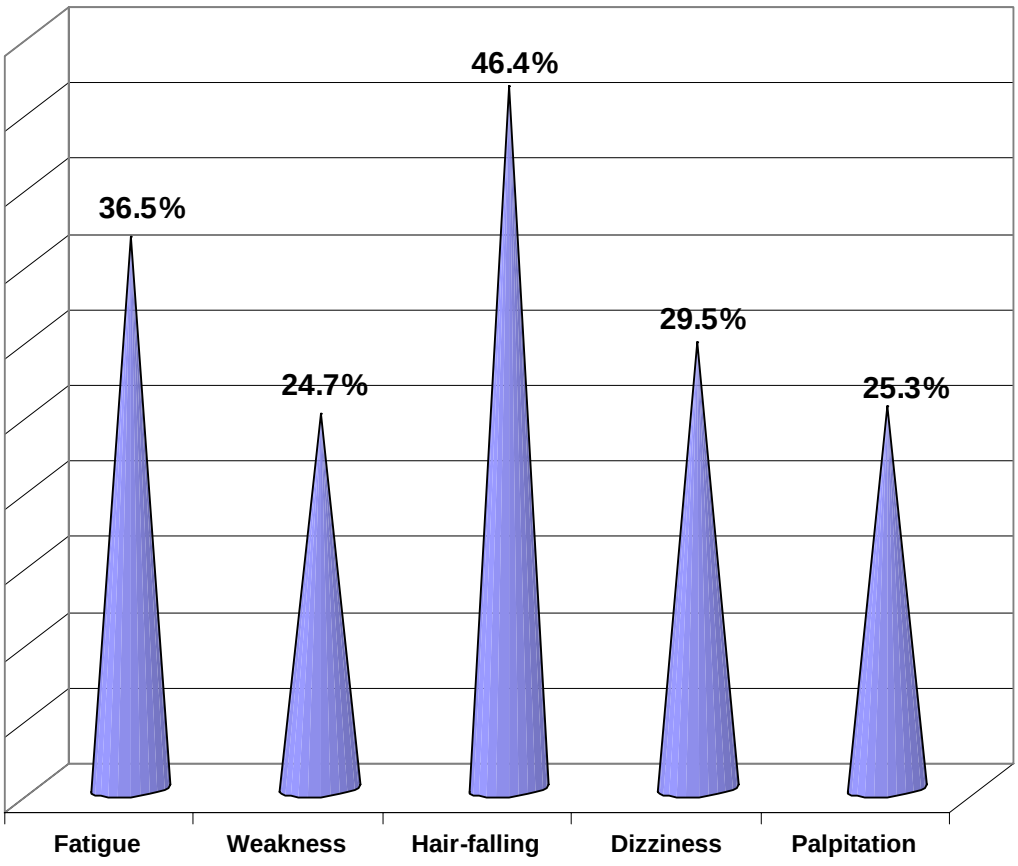


Table 9 shows that 3.8% of the students received iron therapy and 8.8% of them received vitamins during the last 50 days before the date of the interview.

Table (9) Distribution of History of Iron and Vitamins Intake During 30 Days Prior to the Interview, Khartoum State, September 2006 (n = 810)

Medicine / Received		Iron	Vitamins
Yes	Number	31	71
	%	3.8	8.8
No	Number	779	739
	%	96.2	91.2

The majority of the female students 96.6% had a regular menstrual cycle with a frequency of one cycle per month, while 3.4% of them had more than one cycle per month, (Table 10).

Table (10) Distribution of the Number of Menstrual Cycles per Month, Khartoum State, September 2006 (n = 551)

Number of cycles per month	Frequency	Percent %
1	**532**	**96.6**
>1	**19**	**3.4**
Total	**551**	**100**

The majority of the girls 56.6% of the girls had a normal duration of the menstrual cycle i.e. 3-5 days per month. The mean duration of the menstrual cycles was 5.2 ± 0.09 (Table 11).

Table (11) Distribution of the Duration of the Menstrual Cycle, Khartoum State, September 2006 (n = 551)

Duration of the cycle	Frequency	Percent %
<3	43	7.8
3-5	312	56.6
>5	196	35.6
Total	551	100

3.3: Anaemia:

Table 12 shows the overall prevalence of anaemia **(**i.e. males and females) in the university students living in the public hostels, which was 26.2%. (Mean Hb = 13 gm/dl ± 0.06).

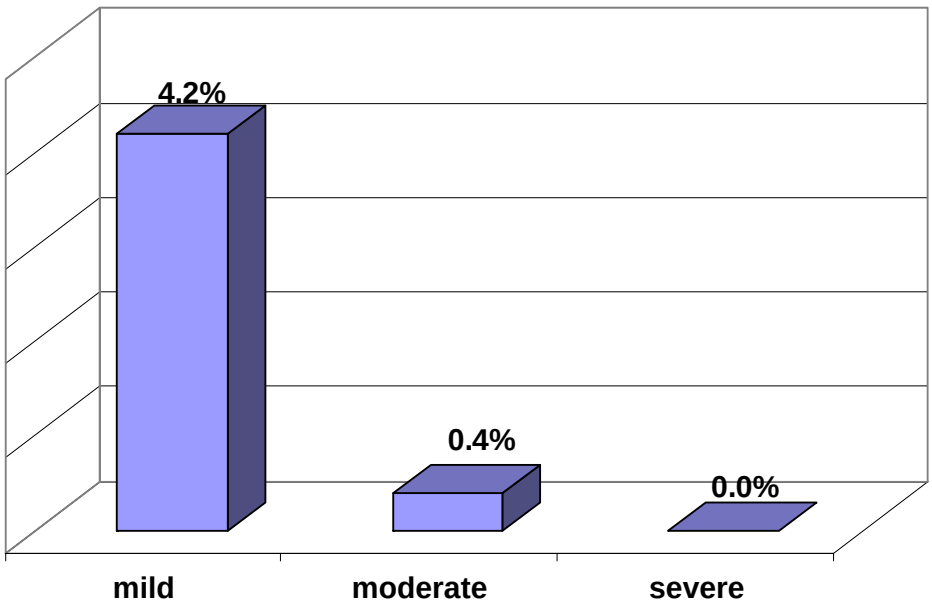
4.6% of the male students were found anaemic (Mean Hb = 14.8 gm/dl ± 0.07). And 36.6% of the female students were anaemic (Mean Hb = 12.1 gm/dl ± 0.05). And only one girl had haemoglobin less than (70g/dl).

Table (12) Overall Prevalence of Anaemia and by Gender (n= 810)

Anaemia	NO	Frequency	Percent %
Overall prevalence	810	212	26.2
Males	259	12	4.6
Females	551	200	36.3

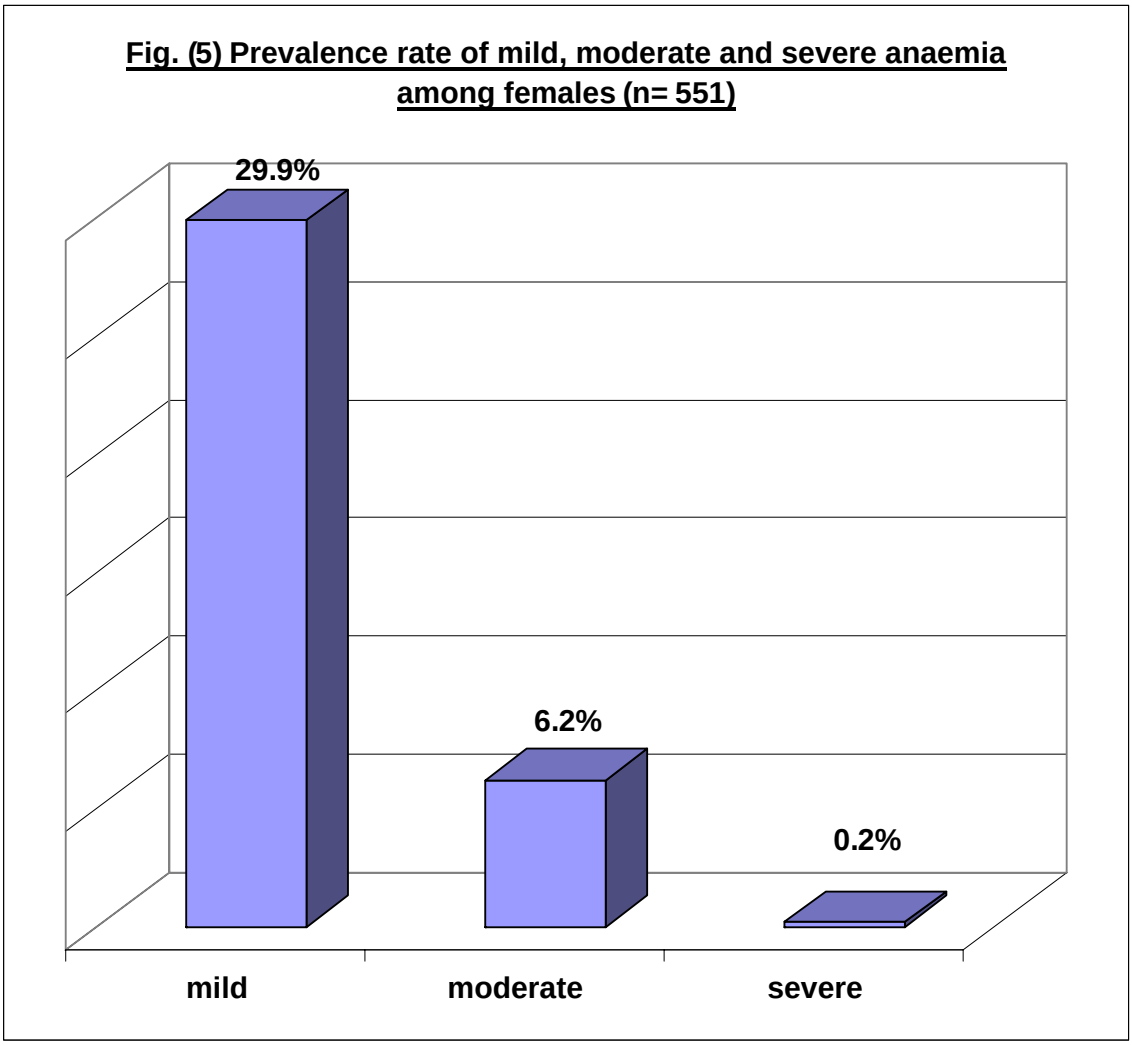
According to WHO classification for severity of anaemia, 4.2 % of the male students were found to have mild anaemia, 0.4 had moderate and none of them had severe anaemia (Fig. 4).

Fig.(4) Prevalence rate of mild, moderate and severe anaemia among males (n= 259)



The 551 girls were classified according to the severity of anaemia. 29.9% of them were found to have mild anaemia, 6.2% had moderate and one girl only (0.2%) had severe anaemia (Fig. 5).

Fig. (5) Prevalence rate of mild, moderate and severe anaemia among females (n= 551)



Cross tabulation performed to see the relationship between anaemia and some variables, Table 13 shows that there is a significant decrease in the prevalence of anaemia with increase of age. The prevalence was 28.1% among the age group 16-19 years old, while the recorded prevalence among the age group more than 28 years was 4.3%. The difference was statistically significant ($P < 0.05$) between different age groups as regards to the prevalence of anaemia.

Table (13) Relationship Between Age and Anaemia (n = 810)

Age in years	Anaemic	Normal	Total
16-19	59 28.1%	151 71.9%	210 100%
20-23	131 27.5%	346 72.5%	477 100%
24-27	21 21%	79 79%	100 100%
28+	1 4.3%	22 95.7%	23 100%
Total	212 26.2%	598 73.8%	810 100%

P-value = (0.049)

Anaemia is more prevalent in families with more than 3 members and the difference is not significant (Table 14)

Table (14) Relationship Between Family Size and Anaemia (n = 802)

Family size	Anaemic	Normal	Total
1-2	2 18.2%	9 81.8%	11 100%
3-5	21 27.3%	56 72.7%	77 100.0%
>5	185 25.9%	529 74.1%	714 100.0%
Total	208 25.9%	594 74.1%	802 100.0%

P-value = (0.0812)

Table 15 shows that there is no statistically significant difference in anaemia between students in faculties of sciences and those in faculties of arts.

Table (15) Relationship Between Type of the Faculty and Anaemia

(n = 810)

Type of faculty	**Anaemic**	**Normal**	Total
Faculties of Sciences	163 26.6%	450 73.4%	613 100.0%
Faculties of Arts	49 25.0%	148 75.0%	197 100.0%
Total	212 26.2%	598 73.8%	810 100.0%

P-value = (0.659)

Anaemia is less prevalent among senior students (19.2%), than in juniors ones (26.2%) but there is increase in the 4th class students (30.4%). However, there is no statistically significant difference among various classes (Table 16).

Table (16) Relationship Between the Academic Year and Anaemia

(n = 810)

Academic year	Anaemic	Normal	Total
1st year	44 26.2%	124 73.8%	168 100.0%
2nd year	65 26.1%	184 73.9%	249 100.0%
3rd year	49 24.7%	149 75.3%	198 100.0%
4th year	49 30.4%	112 69.6%	161 100.0%
5th year	5 19.2%	21 80.8%	26 100.0%
6th year	0 .0%	8 100.0%	8 100.0%
Total	212 26.2%	598 73.8%	810 100.0%

P-value = (0.391)

Anaemia prevalence was equally distributed between urban students (25.5%) and rural ones (26.7%), however, the result was statistically not significant (Table 17).

Table (17) Relationship Between Residence and Anaemia (n = 810)

Residence	Anaemic	Normal	Total
Urban	95 25.5%	277 74.5%	372 100.0%
Rural	117 26.7%	321 73.3%	438 100.0%
Total	212 26.2%	598 73.8%	810 100.0%

P-value = (0.383)

There was a significant increase of anaemia prevalence (from 23% to 32.5%) with increase in income, then the prevalence decreased to 18% with income more than 20,000 SD (Table 18).

Table (18) Relationship Between Income and Anaemia

(n = 810)

Income in SD	Anaemic	Normal	Total
<10,000	88 23.0%	295 77.0%	383 100.0%
10,000-15,000	76 30.2%	176 69.8%	252 100.0%
15,100-20,000	37 32.5%	77 67.5%	114 100.0%
>20,000	11 18.0%	50 82.0%	61 100.0%
Total	212 26.2%	598 73.8%	810 100.0%

P-value = (0.036)

Table 19 shows that students who were receiving bursary were more anaemic (28.4%) in comparison to those who were not receiving bursary (23.7%), however, the difference was not statistically significant.

Table (19) Relationship Between Receiving Bursary and Anaemia

(n = 810)

Receiving bursary	Anaemic	Normal	Total
Yeas	122 28.4%	308 71.6%	430 100.0%
No	90 23.7%	290 76.3%	380 100.0%
Total	212 26.2%	598 73.8%	810 100.0%

P-value = (0.130)

Table 20 shows significant increase in the prevalence of anaemia with longer duration of the menstrual cycle. It increased from 16.3% when the duration of the cycle was 3 days or less to 41.8% when the cycle period lasted for more than 5 days. The difference was statistically significant (P < 0.005) when the duration of the period was extended for more than 3 days.

Table (20) Relationship Between the Menstrual Cycle Duration and Anaemia among female students (n = 551)

Duration of the menstrual cycle per month	Anaemic	Normal	Total
< 3 days	7 16.3%	36 83.7%	43 100%
3-5 days	111 35.6%	201 64.4%	312 100%
> 5 days	82 41.8%	114 58.2%	196 100%

P-value = (0.006)

The prevalence of anaemia increased significantly (80 %) with positive history of typhoid during the week prior to the study ($P < 0.005$) (odds ratio 11.48) (Table 21)

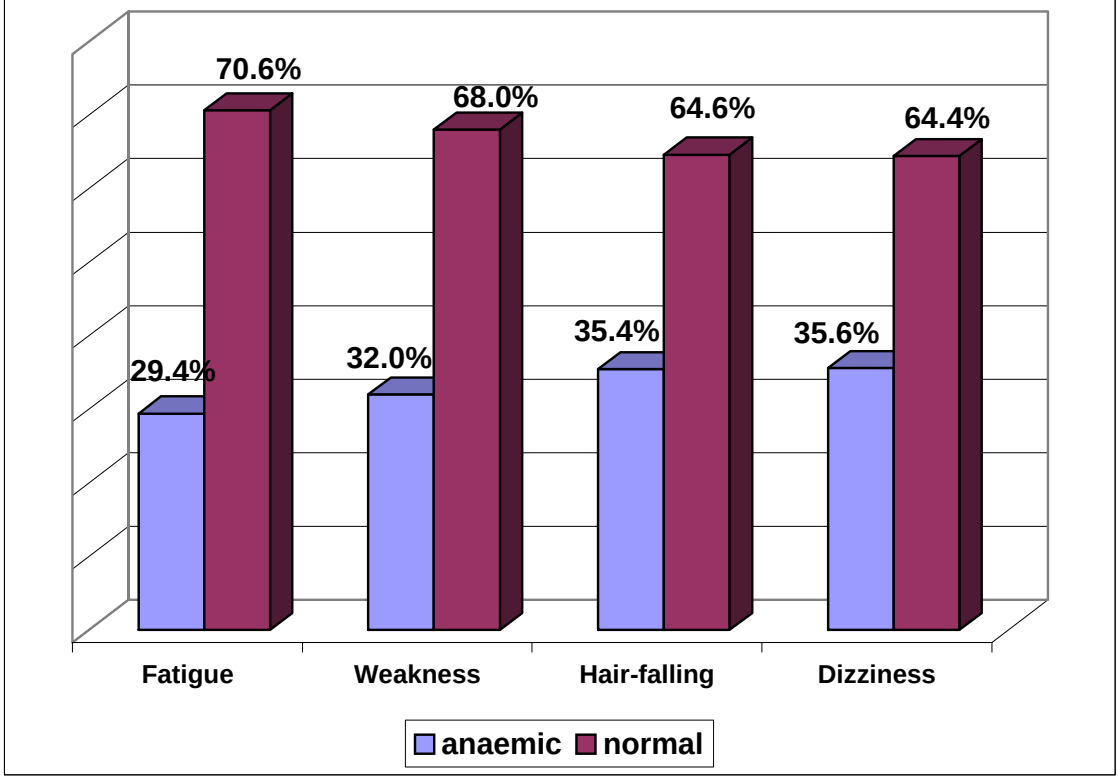
While there was no significant decrease in anaemia in case of malaria (12.9%), infestation with intestinal worms (10%), and with dysentery (40%)

Table (21) Relationship Between Anaemia and Suffering from Typhoid, Malaria, Intestinal Worms and Dysentery During a Week Prior to the Study (n = 810)

Disease		Anaemia		Total	P-value
		Anaemic	Normal		
Typhoid	Yes	4 80.0%	1 20.0%	5 100%	= 0.006
	No	208 25.8%	597 75.7%	805 100%	
Malaria	Yes	4 12.9%	27 87.1%	31 100%	= 0.087
	No	208 26.7%	571 73.3%	779 100%	
Intestinal worms	Yes	1 10.0%	9 90.0%	10 100%	= 0.242
	No	211 26.4%	589 73.6%	800 100%	
Dysentery	Yes	6 40.0%	9 60.0	15 100%	= 0.219
	No	206 35.9%	589 74.1%	795 100%	

Figure 6 shows that 35.6% of the anaemic students were having dizziness, 35.4% of them were having hair-falling, 32% were complaining of weakness and 29.4% were complaining of fatigue. And there is statistically significant relationship (P ranging between 0.031 to 0.000) with weakness, hair falling, dizziness, but not significant with fatigue.

Fig. (6) Relationship Between Common Symptoms of Anaemia and Anaemia (n= 810)



P-value = (0.114, 0.031, 0.000, 0.000) respectively

There was highly statistically significant increase ($P < 0.0001$) in prevalence of anaemia when more than one symptom of anaemia were present. The recorded prevalence of anaemia was 21% when there was one symptom, and 39.4% when there were 4 symptoms (Table 22).

Table (22) Relationship Between Presence of More Than One Symptom and Anaemia (n = 810)

Number of symptoms	Anaemic	Normal	Total
0-1	91 21%	342 79%	433 100%
2-3	78 29.1%	290 70.9%	268 100%
4	43 39.4%	66 60.6%	109 100%
Total	212 26.2%	598 73.8%	810 100%

Pearson Chi-Square = .000

The analysis of the previous relations demonstrated some important relationships between anaemia and other factors such as age, gender, receiving bursary, disease and symptoms. Also it gave a general overview of the growth effect of the differentials on anaemia phenomenon. The principal aim is to assess the net effect of each explanatory variable on the dependant variable using the logistic regression model.

For the logistic regression results it was concluded that, gender had significant relation (P = 0.000) and had the main effect on anaemia among the university students living in public hostels in Khartoum State (Table 23).

Table (23) Logistic Regression Analysis of Anaemia Among University Students Living in Public Hostels.

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Age	-0.073	0.134	0.294	1	0.588	0.930
Gender	-2.418	0.319	57.615	1	0.000	0.089
Bursary	0.000	0.000	0.030	1	0.864	1.000
Disease	1.112	1.086	1.048	1	0.306	3.039
Symptoms	-0.168	0.116	2.121	1	0.145	0.845
Constant	4.429	1.309	11.440	1	0.001	83.836

3.4: Body Mass Index

Height was taken for 808 students and 2 were missing, the mean was found to be 165.2 ± 0.35 cm. And weight measured for 810 the mean = 57.9 ± 0.38 kg.

The body mass index was calculated for each male and female student. According to FAO/WHO/UNU reference tables [33], 30.5% of the male students the body mass index was within desirable weight range (BMI from 20.1 to 25), 67.6% were below the desirable weight range and 1.9% were considered obese (BMI was 30 and above). While 55% of female students were within the desirable weight range (BMI from 18.7 to 23.8), 38.3% of them were below it and 6.7% were obese (BMI was 28.6 and above).

CHAPTER FOUR

4. DISCUSSION

Anaemia is the most common and widespread health problem in both developed and developing countries. The most common type of anaemia is due to iron deficiency anaemia [(11)]. The results of this study indicated that anaemia among university students in public hostels in Khartoum State must be considered as (according to UNICEF criteria) [(2)], a moderate public health problem especially among female students. High rates of anaemia in adolescents have been found in other developing countries such as, Egypt (46.6%), Cameroon (32%), India (55%), and Nepal (42%). [(11)]

Most studies on adolescents (according to WHO, adolescence is defined as the period between 10 years and 19 years) have reported prevalence rates for anaemia ranging from (30% to 55%), the majority of them (80%) were with mild anaemia, few reports have indicated improvement in anaemia status in this age group. The high prevalence of anaemia in this age group is due to increased needs for iron due to rapid

growth, menarche, and low intake of iron rich food. Inappropriate dietary choices and frequent consumption of tea with meals, as its tannic acid slows down the absorption of iron and enhances the prevalence of anaemia. [23]

Certain determinants of anaemia such as age, gender, income, region and presence of infection were examined. Gender had the main effect on prevalence of anaemia, as anaemia is more prevalent among girls. So they were especially at risk because of the blood loss through the menstruation, and the anaemia prevalence is increases with increase of the duration of the menstruation. In many studies done in the region the prevalence of anaemia was between 30% to 55%. [23] A study carried out in Egypt revealed that 41.5% of Egyptian girls aged 16 to 19 had anaemia. [11] A study in Turkey showed that 40% of women between 19 to 40 years old had anaemia, and 33.8% had iron deficiency anaemia. Iron deficiency anaemia had been reported to be low in most European countries i.e. 5% in women aged 20 years to 49 years old in Netherlands and 2.2% in Danish women aged 18 years to 30 years. [34]

The prevalence of anaemia in male students in this study was very low (4.6%) as compared with the prevalence of anaemia among Egyptian males aged 16 years to 19 years, which was 33.3%. [11] From the observations made in the hostels, it was found that the male students

spend more money on their meals, and their free movements from and to the hostel help them to have more choices regarding meals intake, but the female students spend more money on other items such as makeup and mobile phones.

The study showed that anaemia prevalence decreased with increase of age and this agrees with the Egyptian study, which proved that adolescents below (16 years) are (1.7 times) at higher estimated risk of anaemia than those (16 years) and above. [11] This decline in prevalence of anaemia with increase of age is due to the end of growth spurt.

The majority of the students living in the public hostels were from poor families, who cannot afford the cost of living in private hostels, where the accommodation environment is much better than the public ones. Furthermore the National Fund helps the poorest students by giving them a monthly bursary, which is still considered not enough to meet their basic needs. So those who were receiving bursary were more anaemic, as they are from low socioeconomic background, with their rural lifestyle and the habitual diet of the rural population, which is rich in carbohydrates and fat.

Prevalence of anaemia was high in regions where the malaria prevalence is high. [25] This study showed that there was no significant

decrease in the prevalence of anaemia with the presence of malaria. This might be due to small number of those who were having positive history of malaria. However a significant relation still was present between the prevalence of anaemia and the prevalence of other infectious diseases such as typhoid, intestinal worms and dysentery.

CONCLUTION

The results of this study showed that anaemia although mainly of mild and moderate severity, is still a health problem among university students living in public hostels in Khartoum State. Anaemia was found to be more prevalent among females in younger age groups, in those having infections and among the poorest ones.

RECOMMENDATIONS

Appropriate programmes for wide-scale nutrition education should be applied especially targeting young girls. Those programmes should be carried out in schools, in universities and in the hostels.

Nutrition education should focus on good eating habits; one short-term solution to anaemia would be a weekly iron supplementation programme for all girls.

Efforts should be targeted to:

- Reduce poverty;
- Improve access to diversified diets;
- Improve health services and sanitation;

Prevention strategies must be sustainable, involve the input and resources of a wide range of sectors and organizations, e.g.: the agriculture. Health, commerce, industry, education, and communication sectors.

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ANNEXES

بسم الله الرحمن الرحيم

ANNEX ONE

الصندوق القومي لرعاية الطلاب

قائمة بأسماء الداخليات التابعة للصندوق القومي لرعاية الطلاب ولاية الخرطوم

م	المحلية	اسم الداخلية	عدد الطلاب	النوع
01	بحري	عبيد ختم	350	طالب
02	بحري	الشهيد عبد السلام	850	طالب
03	بحري	خولة بنت الأزور	444	طالبة
04	بحري	خديجة بنت خويلد	750	طالبة
05	بحري	عاطف التيجاني	968	طالبة
06	بحري	الحميراء	166	طالبة
07	بحري	نسيبة بنت كعب	444	طالبة
08	بحري	الفاروق	180	طالبة

م	المحلية	اسم الداخلية	عدد الطلاب	النوع
01	أم درمان	محمد صالح عمر	2700	طالب
02	أم درمان	أبو ذر الغفاري	360	طالب
03	أم درمان	الشهيد الوليد	380	طالب
04	أم درمان	عبد الله بن عمر	240	طالب
05	أم درمان	السلام	180	طالب
06	أم درمان	الخنساء بمجمع محمد عبد الله خلف الله	728	طالبة
07	أم درمان	على عبد الفتاح	4162	طالبة

08	أم درمان	الخنساء بمجمع على عبد الفتاح	120	طالبة
09	أم درمان	النور المبين	396	طالبة
10	أم درمان	على المك	220	طالبة
11	أم درمان	بنت وهب	204	طالبة
12	أم درمان	بنت خويلد	410	طالبة
13	أم درمان	عزة	162	طالبة
14	أم درمان	الهدي	191	طالبة
15	أم درمان	ذات النطاقين	1841	طالبة
16	أم درمان	بنت الخياط	180	طالبة
17	أم درمان	الرميثاء	190	طالبة
18	أم درمان	المنهل	170	طالبة
19	أم درمان	نسيبة	230	طالبة
20	أم درمان	أم أيمن	160	طالبة
21	أم درمان	الكوثر	360	طالبة
22	أم درمان	خولة	200	طالبة
23	أم درمان	الزهراء	160	طالبة
24	أم درمان	التقوى	200	طالبة
25	أم درمان	البقيع	260	طالبة
26	أم درمان	ثويبة	140	طالبة

م	المحلية	لسم الداخلية	عدد الطلاب	النوع
01	الخرطوم	الفرقان	40	طالب
02	الخرطوم	الأمل	328	طالب
03	الخرطوم	مصعب بن عمير	1863	طالب
04	الخرطوم	أبو دجانة	395	طالب
05	الخرطوم	الوسط	2250	طالب
06	الخرطوم	حسيب والرازي (العلوم الطبية)	1100	طالب
07	الخرطوم	الشهيد إبراهيم شمس الدين	120	طالب
08	الخرطوم	النيل الأبيض	403	طالب
09	الخرطوم	الإنقاذ	130	طالبة
10	الخرطوم	الفضيلة	146	طالبة
11	الخرطوم	السودان الجامعية	1821	طالبة
12	الخرطوم	نسيبة	35	طالبة
13	الخرطوم	سعاد طمبل	851	طالبة
14	الخرطوم	محمد على البلال	130	طالبة
15	الخرطوم	بشائر السلام	1166	طالبة
16	الخرطوم	الزهراء	4387	طالبة
17	الخرطوم	العلوم الطبية	772	طالبة
18	الخرطوم	الرميثاء	50	طالبة

بسم الله الرحمن الرحيم

ANNEX TWO

QUESTIONAIR

DR. Khaled Al Tohami

PREVALENCE AND DETERMINANTS
OF ANAEMIA AMONG
UNVIRSITY STUDENTS LIVING IN PUBLIC HOSTELS IN KHARTOUM
STATE

1\ Serial no. ……. 2\ Date …… 3\ Code no……
4\ Name of the interviewer …….
5\ Sex : ☐ Male (1) Female (2) 6\ Age ……
7\ Marital status ☐ Married (1) Single (2) Divorced (3) Widow (4) Separated (5)
8\ Number of the family members ☐

9\ Name of the university ……..10\ College ……

11\ Class …….. 12\ Name of the hostel ……

13\ Home residence ☐ Urban (1) Rural (2)

14\ Amount of monthly income ……

15\ Receiving bursary ☐ Yes (1) No (2)

16\ During the last week history of malaria ☐ typhoid ☐
intestinal worms ☐ dysentery ☐ Yes (1) No (2)
Others specify ……..

17\ Present symptoms fatigue ☐ weakness ☐
hair falling ☐ dizziness ☐ palpitations ☐ Yes (1) No (2)
Others specify ……..
18\ History of iron intake during the last month ☐ Yes (1) No (2)

19\ History of vitamins intake during the last month ☐ Yes (1) No (2)

20\ Number of cycles per month ……..

21\ Duration of the menstrual cycle ……

22\ Height …… 23\ Weight …….

24\ Blood sample taken ☐ Yes (1) No (2)

بسم الله الرحمن الرحيم

ANNEX TWO

استبيان

الباحث : د . خالد التهامي مدني

معدل انتشار الانيمياء في طلاب الداخليات الحكومية ومحدداته

1 /الرقم المسلسل ..... **2/ التاريخ** .....

3 /رقم الكود: ..... **4/اسم الباحث** .....

5 /النوع: ☐ **ذكر (1)** **أنثي (2)** **6/ العمر:** ☐

7 / الحالة الاجتماعية : ☐ **متزوج(1)** **أعزب(2)** **مطلق (3)** **أرمل(4)** **منفصل(5)**

8/عدد أفراد الأسرة ☐

9 /الجامعة: ..... **10/ الكلية**.....

11 / السنة..... **12 /الداخلية:**.....

13 /السكن الأصلي: ☐ حضر (1) ريف (2)

14/ كم تستلم مصاريف شهري..... **15 / هل تستلم كفالة من الصندوق** ☐ **نعم(1) لا(2)**

16 / خلال الأسبوع الماضي هل أصبت ب : نعم(1) لا(2) **ملاريا** ☐ **تيفويد** ☐ **ديدان** ☐ **دوسنتاريا** ☐

أخري حدد .....

17 / هل تعاني من: نعم(1) لا(2) **الخمول:** ☐ **الضعف:** ☐

تساقط الشعر: ☐ **الدوار:** ☐ **زيادة ضربات القلب:** ☐

أخري حدد .....

18 / هل أخذت حبوب حديد خلال الثلاثون يوم الماضية: ☐ **نعم(1) لا(2)**

19 / هل تأخذ فتياميينات خلال الثلاثون يوم الماضية: ☐ **نعم(1) لا(2)**

20 /عدد مرات الدورة خلال الشهر: **21 /عدد أيام الدورة الشهرية:** ☐

22 / الطول .... **23/ الوزن** .....

24 /تم سحب الدم للهيموقلوبين: ☐ **نعم(1) لا(2)**